

M.2.3 STORAGE AND DISPOSITION FACILITIES INFORMATION

This section presents compilations of radiological releases to the environment from facilities associated with all alternatives assessed in this PEIS except No Action. The No Action releases are presented as part of the specific site discussions in Section M.2.4 through M.2.9. This section also presents the in-plant worker doses associated with these same facilities.

M.2.3.1 Radiological Releases to the Environment

Long-Term Storage. The annual release of radioactivity to the environment associated with the alternatives for the long-term storage of Pu and highly enriched uranium (HEU) are given in Table M.2.3.1-1. The releases, by radionuclide, are given for operation of upgraded Pu storage facilities at Hanford, INEL, Pantex, and SRS and upgraded HEU storage facilities at ORR; for operation of consolidated Pu storage facilities at Hanford, NTS, INEL, Pantex, and SRS; and for operation of collocated Pu and HEU storage facilities at Hanford, NTS, INEL, Pantex, ORR, and SRS.

Front-End Processes Common to Multiple Plutonium Disposition Alternatives. The annual releases of radioactivity to the environment associated with front-end processes common to multiple Pu disposition alternatives are given in Table M.2.3.1-2. The releases, by radionuclide, include those for operation of a pit disassembly/conversion facility, a Pu conversion facility, and a mixed oxide (MOX) fuel fabrication facility. These releases are independent of site location.

Table M.2.3.1-1. Annual Radioactive Releases During Normal Operation of Long-Term Storage Facilities (curies)^a

Facility/Radionuclides	Site			
	Hanford	INEL	Pantex	SRS
Upgraded Pu Storage Facility				
Pu-238	1.8×10^{-8}	2.5×10^{-9}	b	c
Pu-239	5.6×10^{-8}	9.2×10^{-8}	b	c
Pu-240	2.8×10^{-8}	2.4×10^{-8}	b	c
Pu-241	8.6×10^{-7}	8.6×10^{-8}	b	c
Pu-242	1.6×10^{-11}	3.6×10^{-12}	b	c
Am-241	3.5×10^{-8}	4.5×10^{-10}	b	c
Upgraded HEU Storage Facility		ORR^d		
U-234		2.7×10^{-12}		
U-235		4.7×10^{-11}		
U-236		2.9×10^{-10}		
U-238		9.3×10^{-9}		
Consolidated Pu Storage Facility	Hanford, NTS, INEL, Pantex, and SRS			
Pu-238	1.5×10^{-8}			
Pu-239	5.4×10^{-7}			
Pu-240	1.4×10^{-7}			
Pu-241	5.1×10^{-7}			
Pu-242	2.1×10^{-11}			
Am-241	2.7×10^{-9}			

Table M.2.3.1-1. Annual Radioactive Releases During Normal Operation of Long-Term Storage Facilities (curies)^a —Continued

Facility/Radionuclides	Site
Collocated Pu and HEU Storage Facility	Hanford, NTS, INEL, Pantex, ORR, and SRS
Pu-238	1.5x10 ⁻⁸
Pu-239	5.4x10 ⁻⁷
Pu-240	1.4x10 ⁻⁷
Pu-241	5.1x10 ⁻⁷
Pu-242	2.1x10 ⁻¹¹
Am-241	2.7x10 ⁻⁹
U-234	2.7x10 ⁻¹²
U-235	4.7x10 ⁻¹¹
U-236	2.9x10 ⁻¹⁰
U-238	9.3x10 ⁻⁹

^a All releases are to the atmosphere.

^b Radiation dose for the storage facility is calculated to be 1.8x10⁻⁸ for the MEI and 6.3x10⁻⁶ person-rem for the population within 80 km, but no radionuclide emissions are available (HNUS 1996a).

^c Radiation dose for the storage facility is calculated to be 8.3x10⁻⁶ for the MEI and 3.5x10⁻⁴ person-rem for the population within 80 km, but no radionuclide emissions are available (SR DOE 1995e).

^d Assumed uranium releases from Collocated Storage Facility would be applicable for the ORR Upgraded HEU Storage Facility.

Note: Am=Americium.

Source: DOE 1996e; DOE 1996f; HF 1995a:1; HNUS 1996a; IN DOE 1996a; PX MH 1995a; SRS 1996a:4.

Plutonium Disposition Alternatives. The annual releases of radioactivity to the environment associated with the Pu disposition alternatives are given in Table M.2.3.1-3 for facilities other than reactors, and in Tables M.2.3.1-4 and M.2.3.1-5 for reactors. The releases have been separated to facilitate data presentation since reactors release a much larger number of radionuclides than do the other facilities. Table M.2.3.1-3 presents the releases by radionuclide for operation of ceramic immobilization, vitrification, and the deep borehole complex. Tables M.2.3.1-4 and M.2.3.1-5 present the releases, by radionuclide, for operation of a large and a small evolutionary light water reactor (LWR), respectively.

M.2.3.2 Radiological Impacts to In-Plant Workers

Operation of each of the facilities whose releases were addressed in Section M.2.3.1 result in radiological doses and associated health effects to in-plant workers. The numbers of badged workers, the average and total worker doses, and the risks and numbers of fatal cancers are given in Table M.2.3.2-1 for workers involved with disposition activities. It should be noted that for several disposition facilities, the number of years for facility operation varies due to the fact that the duration of operation depends on the end use of that facility. For example, the MOX fuel fabrication facility could operate for either 17 years supplying fuel for evolutionary and partially completed U.S. reactors or 23 years supplying fuel for existing Canadian Deuterium Uranium reactors.

Based on a review of impacts to workers involved in similar operations, the radiological impacts to workers involved with storage activities assume an annual average dose of approximately 250 mrem per worker for the storage upgrade alternative (HF DOE 1996a:2-4; IN DOE 1996a:1-6; NT DOE 1996a:1-7. For the upgrade at Pantex, an average measurable dose of 116 mrem/yr to radiological workers was assumed to be applicable for the workers associated with storage operations (PX 1996e:2). The number of these involved workers, and therefore the total dose to the involved workforce, is site dependent. For consolidated and collocation storage alternatives that require new facilities, the annual average dose is estimated to be 258 mrem and 264 mrem per worker, respectively. For these storage facilities, the number of involved badged workers are independent of the site and would number 92 and 95, respectively; therefore, the total dose to the involved workforce is also site independent (DOE 1996e:1-6; DOE 1996f:1-8). The detailed results of worker doses associated with all storage facilities are presented in the storage public and occupational health sections of Chapter 4.

Table M.2.3.1-2. Annual Radioactive Releases During Normal Operation of Facilities for Plutonium Disposition Used by Multiple Alternatives (curies)^a

Facility/Radionuclides	Releases
Pit Disassembly/Conversion	
Facility	
Pu-238	4.2×10^{-7}
Pu-239	4.3×10^{-5}
Pu-240	1.0×10^{-5}
Pu-241	3.2×10^{-5}
Pu-242	2.9×10^{-10}
Am-241	1.7×10^{-5}
Pu Conversion Facility	
Pu-238	2.3×10^{-6}
Pu-239	3.6×10^{-5}
Pu-240	1.2×10^{-5}
Pu-241	4.8×10^{-5}
Pu-242	3.8×10^{-9}
Am-241	2.6×10^{-7}
Mixed Oxide Fuel Fabrication	
Facility	
Pu-238	7.9×10^{-7}
Pu-239	2.9×10^{-5}
Pu-240	7.6×10^{-6}
Pu-241	2.7×10^{-5}
Pu-242	1.1×10^{-9}
Am-241	1.4×10^{-7}
U-232	1.3×10^{-7}
U-234	3.2×10^{-8}
U-235	6.2×10^{-10}
U-238	4.8×10^{-8}

^a All releases are to the atmosphere.

Note: Am=Americium.

Source: HNUS 1996a; LANL 1996b; LANL 1996c; LANL 1996d.

Table M.2.3.1–3. Annual Radioactive Releases During Normal Operation of Non-Reactor Plutonium Disposition Facilities (curies)^a

Facility/Radionuclides	Releases
Borehole Complex (Direct Disposition Alternative)	
Pu-238	1.2×10^{-11}
Pu-239	9.2×10^{-10}
Pu-240	2.4×10^{-10}
Pu-241	1.3×10^{-10}
Pu-242	3.6×10^{-14}
Am-241	2.0×10^{-10}
Ceramic Immobilization Facility (Immobilized Disposition Alternative)	
Pu-238	9.3×10^{-11}
Pu-239	7.0×10^{-9}
Pu-240	1.9×10^{-9}
Pu-241	9.7×10^{-10}
Pu-242	2.8×10^{-13}
Am-241	3.5×10^{-11}
Borehole Complex (Immobilized Disposition Alternative)	
Pu-238	1.4×10^{-11}
Pu-239	1.1×10^{-9}
Pu-240	2.8×10^{-10}
Pu-241	1.5×10^{-10}
Pu-242	4.1×10^{-14}
Am-241	3.0×10^{-10}
Vitrification Alternative	
Pu-238	3.7×10^{-8}
Pu-239	2.8×10^{-6}
Pu-240	7.5×10^{-7}
Pu-241	3.9×10^{-7}
Pu-242	1.1×10^{-10}
Am-241	1.4×10^{-8}
Cs-137	5.0×10^{-5}
Ceramic Immobilization Alternative	
Pu-238	9.3×10^{-11}
Pu-239	7.0×10^{-9}
Pu-240	1.9×10^{-9}
Pu-241	9.7×10^{-10}
Pu-242	2.8×10^{-13}
Am-241	3.5×10^{-11}
Cs-137	1.0×10^{-5}

^a All releases are to the atmosphere.

Note: Am=Americium.

Source: HNUS 1996a; LLNL 1996a; LLNL 1996c; LLNL 1996d; LLNL 1996e; LLNL 1996h.

Table M.2.3.1-4. Annual Liquid and Atmospheric Radioactive Releases From the Large Evolutionary Light Water Reactor Using a Mixed Oxide Core (curies)

Isotope	Release			Isotope	Release		
	Wet Site ^a		Dry Site ^a		Wet Site ^a		Dry Site ^a
	Atmospheric	Liquid	Atmospheric		Atmospheric	Liquid	Atmospheric
H-3	6.8x10 ¹	6.0x10 ¹	1.3x10 ²	Sr-92	7.8x10 ⁻⁴	8.0x10 ⁻⁴	1.6x10 ⁻³
C-14	9.2	1.6x10 ⁻⁴	9.2	Y-90	1.7x10 ⁻⁵	1.2x10 ⁻⁶	1.9x10 ⁻⁵
Ar-41	6.8	0	6.8	Y-91	1.5x10 ⁻⁴	6.7x10 ⁻⁵	2.1x10 ⁻⁴
Kr-83m	1.4x10 ⁻³	0	1.4x10 ⁻³	Y-92	4.5x10 ⁻⁴	4.3x10 ⁻⁴	8.8x10 ⁻⁴
Kr-85m	2.3x10 ¹	0	2.3x10 ¹	Y-93	1.0x10 ⁻³	8.3x10 ⁻⁴	1.8x10 ⁻³
Kr-85	4.9x10 ²	0	4.9x10 ²	Zr-95	1.0x10 ⁻³	7.4x10 ⁻⁴	1.8x10 ⁻³
Kr-87	2.5x10 ¹	0	2.5x10 ¹	Nb-95	1.5x10 ⁻³	8.8x10 ⁻⁴	2.4x10 ⁻³
Kr-88	3.7x10 ¹	0	3.7x10 ¹	Mo-99	1.4x10 ⁻²	7.9x10 ⁻⁴	1.5x10 ⁻²
Kr-89	4.0x10 ²	0	4.0x10 ²	Tc-99m	3.0x10 ⁻⁴	8.0x10 ⁻⁴	1.1x10 ⁻³
Kr-90	5.4x10 ⁻⁴	0	5.4x10 ⁻⁴	Ru-103	6.0x10 ⁻⁴	2.2x10 ⁻⁴	8.3x10 ⁻⁴
Xe-131m	8.6x10 ¹	0	8.6x10 ¹	Rh-103m	1.1x10 ⁻⁴	9.0x10 ⁻⁶	1.2x10 ⁻⁴
Xe-133m	1.4x10 ⁻¹	0	1.4x10 ⁻¹	Ru-106	3.2x10 ⁻⁵	2.9x10 ⁻⁴	3.2x10 ⁻⁴
Xe-133	3.8x10 ³	0	3.8x10 ³	Rh-106	1.9x10 ⁻⁵	1.7x10 ⁻⁴	1.9x10 ⁻⁴
Xe-135m	6.8x10 ²	0	6.8x10 ²	Ag-110m	6.5x10 ⁻⁷	3.3x10 ⁻⁴	3.3x10 ⁻⁴
Xe-135	2.2x10 ³	0	2.2x10 ³	Sb-124	1.7x10 ⁻⁴	3.6x10 ⁻⁴	5.3x10 ⁻⁴
Xe-137	8.6x10 ²	0	8.6x10 ²	Te-129m	1.7x10 ⁻⁴	1.3x10 ⁻⁵	1.8x10 ⁻⁴
Xe-138	7.2x10 ²	0	7.2x10 ²	Te-131m	9.1x10 ⁻⁵	4.1x10 ⁻⁵	1.3x10 ⁻⁴
Xe-139	6.8x10 ⁻⁴	0	6.8x10 ⁻⁴	I-131	2.9x10 ⁻¹	3.5x10 ⁻³	2.9x10 ⁻¹
Na-24	4.1x10 ⁻³	2.8x10 ⁻³	6.9x10 ⁻³	Te-132	2.0x10 ⁻⁵	4.3x10 ⁻⁶	2.5x10 ⁻⁵
P-32	9.2x10 ⁻⁴	1.8x10 ⁻⁴	1.1x10 ⁻³	I-132	2.3	2.8x10 ⁻³	2.3
Cr-51	3.5x10 ⁻²	7.7x10 ⁻³	4.3x10 ⁻²	I-133	1.6	9.5x10 ⁻³	1.6
Mn-54	4.9x10 ⁻³	2.6x10 ⁻³	7.5x10 ⁻³	I-134	3.6	1.6x10 ⁻³	3.6
Mn-56	3.5x10 ⁻³	3.8x10 ⁻³	7.3x10 ⁻³	Cs-134	8.9x10 ⁻⁵	3.2x10 ⁻³	3.3x10 ⁻³
Fe-55	6.5x10 ⁻³	5.8x10 ⁻³	1.2x10 ⁻²	I-135	2.4	7.5x10 ⁻³	2.4
Co-56	0	5.2x10 ⁻³	5.2x10 ⁻³	Cs-136	1.2x10 ⁻⁴	4.7x10 ⁻⁴	5.8x10 ⁻⁴
Co-57	0	7.2x10 ⁻⁵	7.2x10 ⁻⁵	Cs-137	4.2x10 ⁻⁴	8.2x10 ⁻³	8.6x10 ⁻³
Co-58	2.4x10 ⁻³	9.0x10 ⁻⁵	2.5x10 ⁻³	Cs-138	1.7x10 ⁻⁴	1.9x10 ⁻⁴	3.6x10 ⁻⁴
Co-60	1.1x10 ⁻²	9.1x10 ⁻³	2.0x10 ⁻²	Cs-139	8.2x10 ⁻⁵	0	8.2x10 ⁻⁵
Fe-59	6.5x10 ⁻⁴	1.0x10 ⁻⁴	7.5x10 ⁻⁴	Ba-140	1.2x10 ⁻²	6.1x10 ⁻⁴	1.2x10 ⁻²
Ni-63	6.5x10 ⁻⁶	1.4x10 ⁻⁴	1.5x10 ⁻⁴	La-140	1.6x10 ⁻³	1.5x10 ⁻⁴	1.8x10 ⁻³
Cu-64	1.0x10 ⁻²	7.5x10 ⁻³	1.8x10 ⁻²	Ce-141	8.6x10 ⁻³	1.2x10 ⁻⁴	8.8x10 ⁻³
Zn-65	8.1x10 ⁻³	9.0x10 ⁻⁵	8.2x10 ⁻³	Ce-144	1.3x10 ⁻⁵	1.3x10 ⁻³	1.3x10 ⁻³
Rb-89	4.3x10 ⁻⁵	4.4x10 ⁻⁵	8.7x10 ⁻⁵	Pr-143	0	1.1x10 ⁻⁶	1.1x10 ⁻⁶
Sr-89	3.2x10 ⁻³	6.3x10 ⁻⁵	3.3x10 ⁻³	Pr-144	1.9x10 ⁻⁵	0	1.9x10 ⁻⁵
Sr-90	2.8x10 ⁻⁵	1.5x10 ⁻⁵	4.3x10 ⁻⁵	W-187	1.9x10 ⁻⁴	9.5x10 ⁻⁵	2.8x10 ⁻⁴
Sr-91	6.5x10 ⁻⁴	5.9x10 ⁻⁴	1.2x10 ⁻³	Np-239	5.9x10 ⁻³	1.6x10 ⁻³	7.5x10 ⁻³

^a A wet site is characterized by the potential for effluent material to be emitted either through airborne or liquid pathways. A dry site only exhibits the potential to emit effluent material via the airborne pathway. For a dry site, it was conservatively assumed that liquid and atmospheric effluents are released into the atmosphere.

Source: HNUS 1996a.

Table M.2.3.1-5. Annual Liquid and Atmospheric Radioactive Releases From the Small Evolutionary Light Water Reactor Using a Mixed Oxide Core (curies)

Release				Release			
Isotope	Wet Site ^a		Dry Site ^a	Isotope	Wet Site ^a		Dry Site ^a
	Atmospheric	Liquid	Atmospheric		Atmospheric	Liquid	Atmospheric
H-3	8.4x10 ¹	7.5x10 ⁻²	8.4x10 ²	Nb-95	2.1x10 ⁻³	1.6x10 ⁻³	3.7x10 ⁻³
C-14	7.3	0	7.3	Mo-99	0	7.9x10 ⁻⁴	7.9x10 ⁻⁴
Ar-41	3.4x10 ¹	0	3.4x10 ¹	Tc-99m	0	4.6x10 ⁻⁴	4.6x10 ⁻⁴
Kr-85m	3.2x10 ¹	0	3.2x10 ¹	Ru-103	1.0x10 ⁻⁴	1.8x10 ⁻³	1.9x10 ⁻³
Kr-85	1.7x10 ²	0	1.7x10 ²	Rh-103m	0	1.1x10 ⁻³	1.1x10 ⁻³
Kr-87	9.5	0	9.5	Ru-106	1.4x10 ⁻⁴	3.9x10 ⁻²	3.9x10 ⁻²
Kr-88	3.4x10 ¹	0	3.4x10 ¹	Ag-110m	0	1.4x10 ⁻³	1.4x10 ⁻³
Xe-131m	2.0x10 ³	0	2.0x10 ³	Sb-124	0	4.3x10 ⁻⁴	4.3x10 ⁻⁴
Xe-133m	8.9x10 ¹	0	8.9x10 ¹	Sb-125	6.1x10 ⁻⁵	0	6.1x10 ⁻⁵
Xe-133	4.7x10 ³	0	4.7x10 ³	Te-129m	0	3.9x10 ⁻⁵	3.9x10 ⁻⁵
Xe-135m	9.8	0	9.8	Te-129	0	3.8x10 ⁻⁵	3.8x10 ⁻⁵
Xe-135	5.4x10 ²	0	5.4x10 ²	Te-131m	0	1.7x10 ⁻⁴	1.7x10 ⁻⁴
Xe-138	4.6	0	4.6	Te-131	0	3.0x10 ⁻⁵	3.0x10 ⁻⁵
Na-24	0	3.2x10 ⁻³	3.2x10 ⁻³	I-131	7.3x10 ⁻²	3.6x10 ⁻²	1.1x10 ⁻¹
P-32	0	1.8x10 ⁻⁴	1.8x10 ⁻⁴	Te-132	0	2.1x10 ⁻⁴	2.1x10 ⁻⁴
Cr-51	6.1x10 ⁻⁴	5.2x10 ⁻³	5.8x10 ⁻³	I-132	0	2.4x10 ⁻³	2.4x10 ⁻³
Mn-54	4.4x10 ⁻⁴	4.0x10 ⁻³	4.4x10 ⁻³	I-133	2.4x10 ⁻¹	2.0x10 ⁻²	2.6x10 ⁻¹
Fe-55	0	7.4x10 ⁻³	7.4x10 ⁻³	I-134	0	8.6x10 ⁻⁵	8.6x10 ⁻⁵
Co-57	8.2x10 ⁻⁶	0	8.2x10 ⁻⁶	Cs-134	1.5x10 ⁻³	1.8x10 ⁻²	1.9x10 ⁻²
Co-58	2.3x10 ⁻²	8.6x10 ⁻³	3.2x10 ⁻²	I-135	0	1.4x10 ⁻²	1.4x10 ⁻²
Co-60	8.7x10 ⁻³	1.4x10 ⁻²	2.3x10 ⁻²	Cs-136	1.1x10 ⁻⁴	2.0x10 ⁻³	2.1x10 ⁻³
Fe-59	7.9x10 ⁻⁵	2.2x10 ⁻³	2.3x10 ⁻³	Cs-137	3.7x10 ⁻³	3.8x10 ⁻²	4.2x10 ⁻²
Ni-63	0	1.7x10 ⁻³	1.7x10 ⁻³	Ba-140	3.9x10 ⁻⁴	2.5x10 ⁻³	2.9x10 ⁻³
Zn-65	0	8.0x10 ⁻⁵	8.0x10 ⁻⁵	La-140	0	2.6x10 ⁻³	2.6x10 ⁻³
Sr-89	1.7x10 ⁻³	6.3x10 ⁻⁵	1.8x10 ⁻³	Ce-141	3.9x10 ⁻⁵	2.4x10 ⁻⁴	2.7x10 ⁻⁴
Sr-90	6.0x10 ⁻⁴	1.0x10 ⁻⁵	6.1x10 ⁻⁴	Ce-143	0	2.3x10 ⁻⁴	2.3x10 ⁻⁴
Sr-91	0	3.2x10 ⁻⁵	3.2x10 ⁻⁵	Ce-144	0	3.6x10 ⁻³	3.6x10 ⁻³
Y-91m	0	3.0x10 ⁻⁵	3.0x10 ⁻⁵	Pr-144	0	5.8x10 ⁻⁴	5.8x10 ⁻⁴
Y-91	0	5.7x10 ⁻⁵	5.7x10 ⁻⁵	W-187	0	2.2x10 ⁻⁴	2.2x10 ⁻⁴
Y-93	0	1.7x10 ⁻⁴	1.7x10 ⁻⁴	Np-239	0	1.0x10 ⁻⁴	1.0x10 ⁻⁴
Zr-95	8.5x10 ⁻⁴	1.0x10 ⁻³	1.9x10 ⁻³				

^a A wet site is characterized by the potential for effluent material to be emitted either through airborne or liquid pathways. A dry site only exhibits the potential to emit effluent material via the airborne pathway. For a dry site, it was conservatively assumed that liquid and atmospheric effluents are released into the atmosphere.

Source: HNUS 1996a.

Table M.2.3.2-1. Potential Radiological Impacts From Normal Operation to Involved Workers of Disposition Technology Alternatives and Common Activities

Facility	Years of Operation	Involved "Badged" Workforce	Average Worker Dose (mrem/yr)	Risk of Fatal Cancer ^a	Total Dose (person-rem/yr)	Fatal Cancers ^a
Front-End Processes (Common to Multiple Disposition Alternatives)						
Pit Disassembly and Conversion Facility [Text deleted.]	10	415	200	1.3×10^{-3}	83	0.33
Pu Conversion Facility [Text deleted.]	10	572	233	9.3×10^{-4}	133	0.53
MOX Fuel Fabrication Facility	17	125	250	1.7×10^{-3}	31	0.21
	23	125	250	2.3×10^{-3}	31	0.29
Plutonium Disposition Alternatives						
Direct Disposition Alternative						
Deep Borehole Complex	10	205	13	5.2×10^{-5}	2.7	0.011
Immobilized Disposition Alternative						
Ceramic Immobilization Facility	10	450	240	9.8×10^{-4}	110	0.44
Deep Borehole Complex	10	168	13	5.2×10^{-5}	2.2	8.8×10^{-3}
Vitrification Alternative	10	550	200	8.0×10^{-4}	110	0.44
Ceramic Immobilization Alternative	10	430	279	1.1×10^{-3}	120	0.48
Electrometallurgical Treatment Alternative	10	73	40	1.6×10^{-4}	2.9	0.012
Existing LWR	23	600	281	2.6×10^{-3}	172	1.6
		to 1,000	to 543	to 5.0×10^{-3}	to 602	to 5.5
Partially Completed LWR	23	1,050	360	3.2×10^{-3}	380	3.5
Evolutionary LWR						
Small	17	125	800	5.4×10^{-3}	100	0.68
Large	17	210	810	5.5×10^{-3}	170	1.2

^a As the result of operations for the number of years given in the first column.

Source: LANL 1996b; LANL 1996c; LANL 1996d; LLNL 1996a; LLNL 1996b; LLNL 1996c; LLNL 1996d; LLNL 1996e; LLNL 1996g; LLNL 1996h; NRC 1995b; ORNL 1995b.